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ABSTRACT

The dramatic changes that occurred in information technology in the 1990s have rendered the curricular offerings of many college and university information systems and computer science programs obselete. This paper identifies some of the most desirable skills in the current technology environment. By being astute innovators with college curricula, educators can ensure that graduates receive a quality education and also be competitive in the marketplace. A study by the Information Technology Association of America estimates that there are 190,000 vacant information technology jobs available. The most sought after technicians are programmers for products such as Germany's SAP or its United States rivals Oracle and PeopleSoft. Opportunities for conversion work for the year 2000 and beyond will be readily available. Another "hot area" is experience with a relational database and an emphasis on client/server programming; experience with more than one database will further ensure job opportunities. In addition to technical skills, interpersonal skills and "real-world" experience obtained through an internship or co-op program are important. After a brief description of the Duquesne University (Pennsylvania) Information Technology Program, a table of the Undergraduate Information Technology (IT) Prequisites and Sequencing and a chart of the Undergraduate IT Curriculum are presented. (Contains 20 references.) (AEF)

Is Your Curriculum Up-to-Date

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Abstract

The dramatic changes that occurred in information technology in the 1990's have rendered the curricular offerings of many college and university information systems and computer science programs obsolete. Traditional curricula that have not been updated in the past several years may not be providing the skill base students need to compete in today's technology work environment. Maintaining currency requires a constant process of monitoring technological innovation and market conditions.

This session will identify some of the most desirable skills in the current technology environment and provide a forum for interactive discussion of how to incorporate the desirable skills in a curriculum. A sample curriculum plan will be presented for discussion purposes.

Introduction

Today's successful information systems professionals must demonstrate strong analytical and communications abilities along with a willingness to participate in life-long learning. Our educational programs can equip students with the foundation knowledge and skills necessary to begin careers as information systems professionals; as professionals however, they must have a commitment to continue the learning process throughout their careers. In addition to technical expertise, information systems professionals must also demonstrate excellent "soft skills". General communications, interpersonal and organizational skills are extremely important in the management of people, in the negotiations process, and in interdepartmental and inter-business dealings.

The Changing Nature of Higher Education

Educational programs in computing and information systems cannot be static. The field is changing and evolving rapidly, and all indications are that it will continue its rapid rate of change in the future. For years, businesses have wrestled with the reluctance of people to want to change. Educational programs, especially those related to technology, are faced with many of the same problems. Faculty wish to continue to teach the material that provides them with a "comfort zone", often at the expense of the preparedness of their students. It is difficult for many information systems faculty to be aware and to maintain pace with the rapid rate of change in the field. To compound matters, many institutions do not have adequate budgets to maintain hardware or software currency in their computer laboratories. In addition to serving our students, there are other reasons that make change an important consideration.

Higher education in general is currently facing many challenges, some related to the very technology that we teach. Will our campuses disappear in the future? Although virtual colleges continue to struggle with the stigma of their forebears, virtual degrees are now being offered by about 300 colleges and universities (Hamilton,1997). Not even staunch proponents of online education believe academia's hallowed halls will disappear any time soon, but there is one notable exception. Peter Drucker, at age 87, is generally regarded as one of the most perceptive observers of the American scene. Drucker opines "Thirty years from now the big university campuses will be relics. Universities won't survive. It's as large a change as when we first got the printed book. ...Already we are beginning to deliver more lectures and classes off campus via satellite or two way radio at a fraction of the cost." As Drucker alludes to the rapid growth and acceptance of distance learning, he also states that "the cost of higher education has risen as fast as the cost of health care and, as a result, higher education as we know it is in deep crisis" (Lenzner and Johnson, 1997).

The uncertainty of what will happen with distance learning also poses a threat to each of us and our programs. As alliances are formed among institutions of higher education, the alliances could signal an end to the traditional means of course delivery. For example, BBN Systems and Technologies envisions educational programs as entities within an electronic mall. BBN "envisions a world where personalized learning occurs when and where the individual or community needs it, freed from traditional restraints of time and place" (BBN, 1997). The subscriber will have an opportunity to choose best-in-class courses from the electronic mall, at a time that is convenient, and the courses will be delivered via the Internet. The obvious threat is one of competitiveness. If our programs and courses are not the best-in-class, they will never be chosen. If we find the demographic data credible which indicates that, in the future, there will be more students of non-traditional age attending college classes than those of traditional age, it is not difficult to believe that distance education will be a very popular mode of delivery.

How about the threat of corporate universities? Can we afford to be complacent when more than 400 organizations who provide financial support for our students' education, particularly graduate education, claim that what we teach is not relevant, and therefore they plan to start their own universities? Meister (1996) states that corporations feel there's a gap between what is taught in academic institutions and what corporations require from IS employees. Many of the corporate universities actually plan to seek accreditation from the very same accrediting agencies that accredit us. As corporate universities become accredited, those of us who are skeptics on the basis of claiming that they offer training versus education will be silenced somewhat. The competition will real and we will be forced to deal with it.

The above points are made to serve as a reminder of the amount and type of change that is taking place around us. None of us can afford to ignore change as we, too, can become victims of the change process. Change is difficult, and people resist it. Callon (1996), presents the following Law of Change: "Achieving change, of any significance within an organization, is in inverse proportion to the success that it has had up to the time that management feels a change is needed. The greater the success of the company, the less likely it will change." Those with long-standing successful programs may actually find it more difficult to change. Change and downsizing are not limited exclusively to our friends and neighbors in the corporate world. It is imperative that we offer our students the finest and most up-to-date programs that we are capable of delivering, and that means that we must continuously assess and change.

The Skills That Are in Demand

The question then becomes, How do we go about the process of assessing our curricula and implementing those changes that are appropriate? Where is the fine line that separates education from training? Efrem G. Mallach (1996) contends that we should teach students to work and live during technological change while maintaining evolving curricula. He states that graduates need the skills to get the first job, but more importantly they need the capability to keep learning. Today's technology environment, however, insists on some exposure to current hardware and software tools. The rapid changes that have occurred in information technology over the last several years make it imperative for us to constantly examine our curricula for currency. The basic economic law of supply and demand has created a tremendously rewarding employment environment for those with the proper skill set or experience. It is truly an employee's market, and by being astute innovators with our curricula, we can ensure that our graduates can receive a quality education and also be competitive in the marketplace.

A current study by the Information Technology Association of America estimates that there are 190,000 vacant information technology jobs available (Business Week, 1997). The Big Six consulting firms and hundreds of smaller operations are paying six-figure salaries for technicians. The most sought after technicians are programmers for products such as Germany's SAP or its U.S. rivals Oracle and PeopleSoft (Ibid.).

Another significant area of need is for IS professionals who can resolve the year-2000 problem. Organizations are beginning to panic as they realize that they don't have the staff to handle year-2000 conversions. In particular demand are skills such as COBOL, CICS and the general willingness to make legacy system programs year-2000 compliant (Ulfelder, 1997). Opportunities for conversion work beyond the year-2000 will be available and the 2000 project provides a great opportunity for recent graduates to gain experience.

The fastest growth areas continue to be the Internet and Intranet. One study estimates that there are 760,000 technicians working at Net-related companies, up from virtually none five years ago (Baker, 1997). IS shops have an insatiable demand for networking, Java, and HTML expertise (McGee, 1997) Typical salaries being quoted for those who have one or two years of work experience with web site development, and who are fluent in HTML, are in the range of $50,000 - $75,000. Networking opportunities are greatest for those with knowledge of TCP/IP, Ethernet, and Microsoft NT Server (Menagh, 1996).

Another "hot area" is experience with a relational databases and an emphasis on client/server programming; and if you can boast experience with more than one database, your future is positively rosy (Merragh, 1996). The demands are being escalated because of client/server computing and data warehousing (Lyons, 1997). Many employers are beginning to consider database experience essential and prospective employees will be well-compensated for relational database knowledge, especially when it's combined with other expertise. One observer opines, "If you've got skills in Microsoft, Oracle, and Internet, you'll be making $85,000-$90,000 rather that $40,000 to $45,000" (Ibid.).

The 1997 Computerworld Annual Skills Survey did an excellent job of summarizing and ranking the skills currently in demand (Wilson, 1996). How closely you want your curriculum to resemble the skills listed depends very much on the approach and philosophy of your program.

Wilson reports that those who will be hiring in the next 12 months arrived at a ranking of the top skills across a number of categories (Ibid.). The order in each major group is as follows:

Languages:
HTML, C++, Cobol, Java, C, Micro Focus Cobol
Development Tools:
Microsoft Visual Basic, PowerBuilder, Visual C++, Oracle Developer/2000, Progress, Borland Delphi
Networking:
LU6.2, APPC, TCP/IP
RDBMS Administration:
Oracle, Microsoft SQL Server, Sybase SQL Server, DB2, Informix, Progress
Client/Server Applications:
Oracle, PeopleSoft, SAP
Operating Systems:
Windows NT, Windows 95, Windows, Unix, AIX, DOS, MVS
Lan Administration:
Windows NT Server, Novell NetWare, Ethernet, HTTP, OS/2Warp
Office E-Mail/Groupware:
Microsoft Exchange, Lotus Notes, CC:Mail, Novell GroupWise

As a follow-up to this survey, Wilson (1997) later reported the top five skills for jobs with starting salaries over $40,000. They include; C++, UNIX, Visual C++, HTML, and Microsoft's NT Server.

Employer's are bidding against each other and raiding other companies to acquire the skill sets they need. Not to be forgotten are the previously-mentioned interpersonal skills: "soft skills" are a must. IS managers sound the same litany: "People" will get hired first (Menagh, 1996). Nearly all of the 90 skill areas in the Computerworld survey indicated premiums for seasoned full-time staff and contractors. Employers' willingness to pay salary premiums is an indicator of the favorable employee marketplace (Ibid.).

The technical and interpersonal skills referenced above are essential. However, employers are also placing a great deal of emphasis on another category, namely real-world experience obtained through participation in an internship or co-op program. Wilson (1997) asserts that business experience is important for several reasons. First, students learn about business concepts and terminology which helps with the communications process, and second, students learn to apply the theory they've learned in school to real situations. "A whopping 93% of the recruiters and IS managers in the Computerworld Careers Survey said internships are an important factor on job candidates' resumes"(Ibid.). Other activities which add value include personal development of a Web page or serving as a laboratory assistant (Ibid.).

The Duquesne University Information Technology Program

The Information Technology faculty spent the summer of 1996 revising the former Management Information Systems curriculum in order to reintroduce it as a totally revised program in Information Technology. The general consensus was that information technology is a term that is more appropriate today, and also more likely to make sense with entering freshmen. Management Information Systems, the business school's counterpart of the more recognizable liberal arts' Computer Science program, required an explanation for a typical freshman. Much of the discussion that took place in our curriculum committee meetings centered around the types of competencies that employers will be seeking four and five years hence. There was a great deal of deliberation as the research findings, experience and opinions of six individuals were factored into a very complex equation. Our advisory board, consisting of eighteen middle to high level information systems professionals was consulted. Students who were recent graduates of the program and who are working in an information systems capacity were questioned and asked to identify strengths and weaknesses of the program while providing suggestions. Faculty resources as well as hardware and software resources were considered as was additional faculty training in deficient areas. All of the above were considered important in the curriculum revision effort.

Meeting for half-day sessions no less than three times per month, the project took the entire summer. The outcome of the sessions included agreement among the faculty as to the purpose, scope and sequence of each of 10 courses. In keeping with a School policy, we developed a master syllabus for each of the courses. The master syllabus ensures continuity within the program by stipulating coverage of common and essential topics, regardless of instructor. The instructor, then, is expected to develop his/her course syllabus using the master syllabus as a guide. A rule of thumb is that the instructor's syllabus should follow the "80 - 20 rule"; eighty percent of the content is common and stipulated by the master syllabus and twenty percent is the discretion that an instructor has to customize a course based on personal experience and research. Assistant Professor, Dr. A. Graham Peace agreed to assume the role of chairman of the Curriculum Committee, and coordinated the overwhelming task of the syllabus revision process. The School uses a standard syllabus format, and Dr. Peace was extremely effective as "the enforcer" in accomplishing standardization across all revised syllabi. Such a take-charge person is critical in the development of a set of written curriculum materials that is comprehensive, cohesive, well-articulated. The project would have been doomed for mediocrity had it not been for the efforts of Professor Peace.

The program that resulted is featured in the illustration that follows (Peace, 1997). Obviously, it is not possible to include every "hot skill" that was mentioned in the previous section. We do feel, however, that we are able to provide a very solid conceptual foundation for future learning. The program develops analytical and problem-solving skills while providing experience with some of the in-demand software products. Our rate of student placement, even prior to curriculum revision, was nearly 100 percent. We are confident that students who complete the program that follows will find excellent opportunities in the employment market they will face at graduation.

UNDERGRADUATE I/T PREREQUISITES AND SEQUENCING

- Prerequisites must be completed before taking the listed class.
- Concurrency requirements must be completed before or taken concurrently with the listed class.

Course	Prerequisites	Pre or Concurrency Req.
MIS 182 Info. Sys. I		
MIS 183 Info. Sys. II	MIS 182 Info. Sys. I	
COCS 101 or 150 Prog.	MIS 183 Info. Sys. II	
MIS 382 Programming	COCS 101 or 150 Prog.	
*MIS 384 DSS	COCS 101 or 150 Prog.	
MIS 385 Computer Systems	COCS 101 or 150 Prog.	
MIS 481 Analysis & Design		MIS 482 Database COCS 101 or 150 Prog.
MIS 482 Database		COCS 101 or 150 Prog.
MIS 483 Project	MIS 382 Programming MIS 385 Computer Systems MIS 481 Analysis & Design MIS 482 Database	
MIS 484 Networking	MIS 385 Computer Systems	
*MIS 487 Adv. Sys. Conc.	MIS 481 Analysis & Design MIS 482 Database	
*EDP Auditing	COCS 101 or 150 Prog.	
*Computer Simulation	COCS 101 or 150 Prog.	
*Groupware	COCS 101 or 150 Prog.	

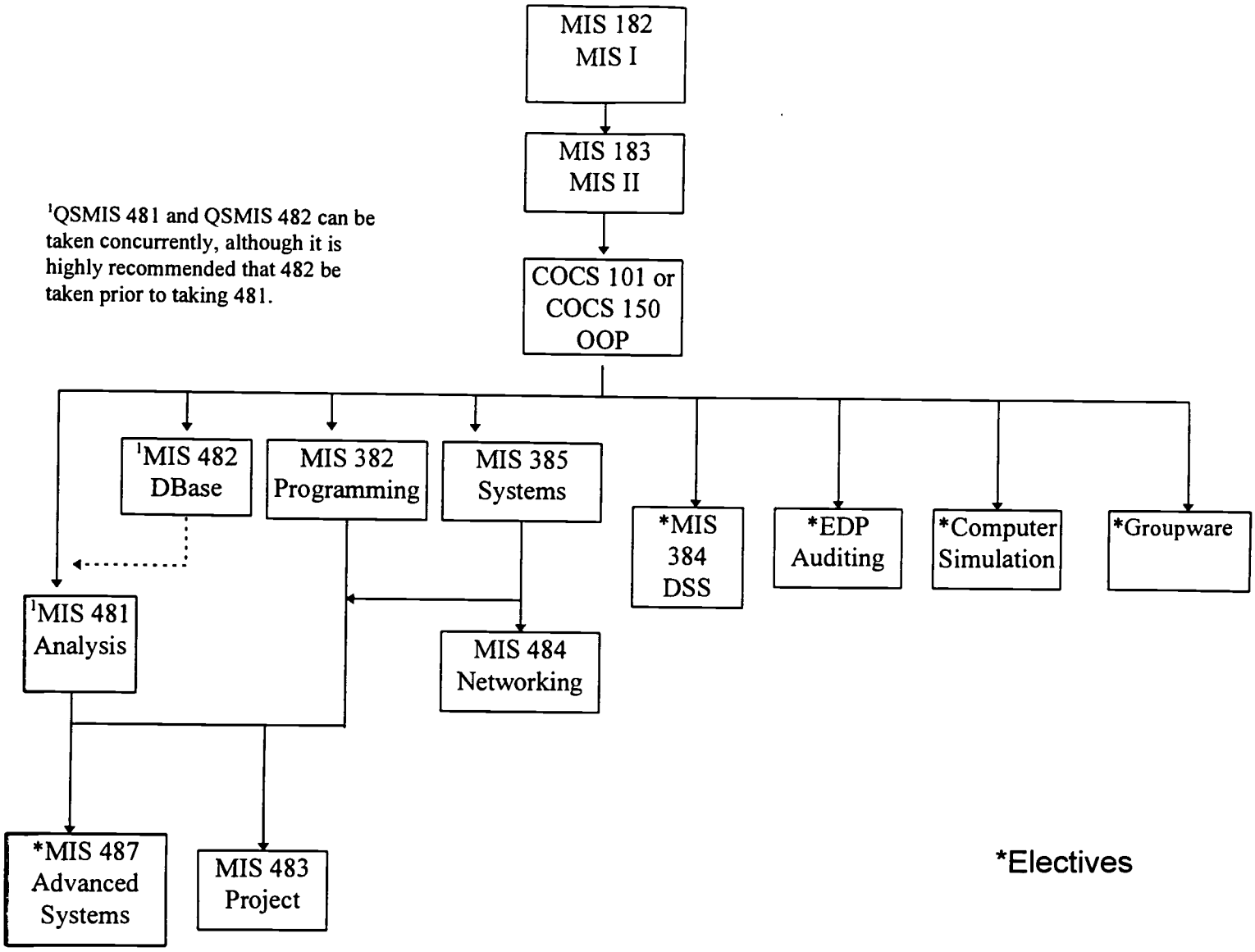
RECOMMENDED PARTIAL COURSE SEQUENCING

Term	Recommended MIS Courses
Freshman Fall Term	MIS 182 Information Systems I
Freshman Spring Term	MIS 183 Information Systems II
Sophomore Year	COCS 101 or 150 Programming
Junior Fall Term	MIS 382 Programming MIS 482 Database
Junior Spring Term	MIS 385 Computer Systems MIS 481 Analysis & Design
Senior Fall Term	*MIS elective MIS 484 Networking
Senior Spring Term	MIS 483 Project *MIS elective

* Electives

- A three credit Internship in either the Junior or Senior year is also very strongly recommended

UNDERGRADUATE I/T CURRICULUM



[1]QSMIS 481 and QSMIS 482 can be taken concurrently, although it is highly recommended that 482 be taken prior to taking 481.

I will now comment briefly on the rationale for design of the illustrated program of studies. As indicated earlier in the paper, the scope and sequence of our course coverage are the result of a very time-intensive, interactive exchange of ideas among the faculty teaching in the Information Technology program. The many ideas incorporated originated from a variety of sources.

Although our students do not officially begin taking business courses until their sophomore year, for the past 12 years, we have front-loaded two technology-intensive courses in the freshman year. Students who are admitted into the business school as freshmen must complete our Information Systems I (MIS I) and Information Systems II (MIS II) courses. Briefly described, the MIS I course provides comprehensive computer literacy including Internet coverage. The Microsoft Suite of products is currently the software of choice. The MIS II course essentially introduces the student to information systems and the importance of information in today's

organizational environments. Also included in the course is a relational database package, currently Access. The rationale for front- loading the two courses is to ensure that all business students have basic computer and information systems competency prior to taking any business-related courses. It is expected that many of the business courses will integrate appropriate software applications and students will be adequately prepared.

During their sophomore year, Information Technology students are required to complete a programming course from the Computer Science Department. Their choice is between Visual BASIC, and C++. The rationale is to develop logical problem-solving skills and a fundamental understanding of the programming process.

During the junior year, students have a more intensive mix of courses from their area of concentration. Hence, most students will take twelve to fifteen credits toward their area of concentration. Included among their courses in the first semester of the junior year is a second required programming course; currently object-oriented COBOL using Micro-Focus COBOL. Students are also advised to take the Introduction to Database Management course concurrently. The course emphasizes relational database management systems and conceptual data modeling, and the software tool is Access. As second semester juniors, students are advised to take the Computer Systems course, dealing with computer hardware and operating systems (including UNIX) and Systems Analysis and Design which stresses the system development process, project management, object-oriented design considerations, and the use of a CASE tool.

During the latter part of the junior year, the summer prior to the senior year, or during the senior year, we strongly advocate an internship experience. Most of our internships are paid and account for three credits, but some students have earned up to six credits through internships. The demands of the internship experience must be increasingly complex to warrant six credit approval. Faculty approval and oversight sponsorship are required.

The curriculum allows for two required courses and two electives during the senior year. Requirements include Networking (Windows NT and Novell) and the capstone course, Project Management which presents a comprehensive live project. A strongly advocated elective, Advanced Systems Concepts advances the educational process in the areas of analysis and design and database management using Oracle as a development tool. Other electives, based on the student's area of interest, include Decision Support Systems, EDP Auditing (offered by the Accounting faculty), Computer Simulation (offered by the Quantitative faculty), and Groupware (currently under development).

Summary

We are facing rapid changes in information technology and in higher education. There are some who feel that if we in higher education do not change, we may be replaced by new organizations that are more nimble, responsive and cost-effective (Kidwell, 1997). In the constantly changing area of information technology, annual curriculum reviews must become a routine practice.

Maintaining awareness of developments in the field and reacting with appropriate curriculum modifications will ensure continuous improvement and well-prepared graduates. Students are

our products, and they will gain competitive advantage for our programs by being stellar performers.

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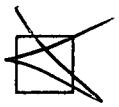

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